

May 2001

SEMI-ANNUAL REPORT

October 2000 - March 2001



Hanford Site
Groundwater/Vadose Zone
Integration Project

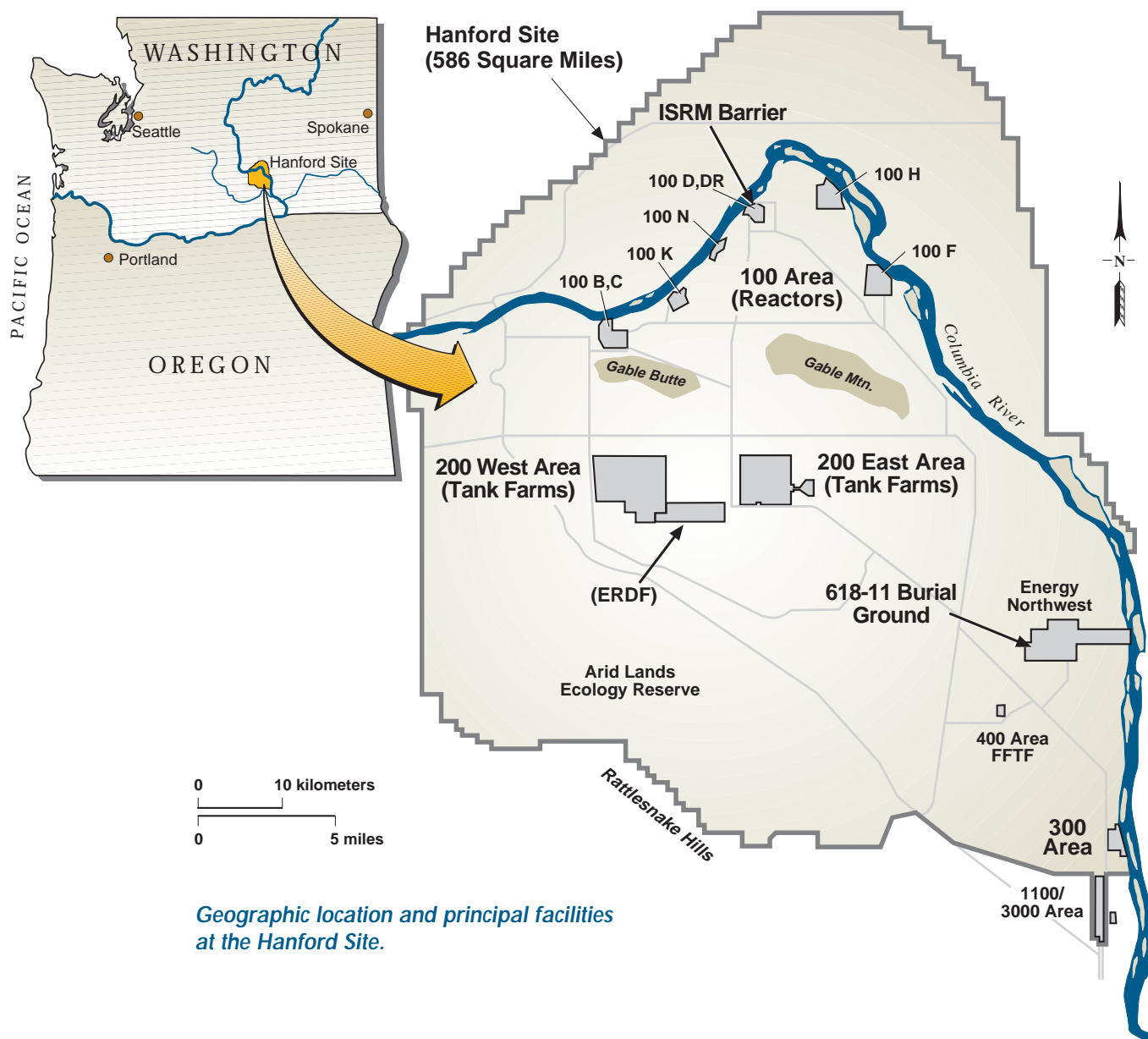
*Understanding the past,
Defining the present,
Shaping the future.*



U.S. Department of Energy
Richland Operations Office



Bechtel Hanford, Inc.
Environmental Restoration Contractor



Geographic location and principal facilities at the Hanford Site.

The Hanford Site is located in a large tract of arid land (approximately 586 square miles) in southeastern Washington. The Columbia River flows through the site, and eventually to the Pacific Ocean. The principal features and facilities of the Hanford Site are shown in the figure above. The arid climate and isolated character of the region made it a particularly attractive site for World War II plutonium production activities, which subsequently continued throughout the Cold War. These activities left a legacy of large volumes of wastes, including toxic chemicals and radioactive substances. Some of these wastes were intentionally (or otherwise) introduced to the vadose zone (the soil above the groundwater), the groundwater, and the Columbia River. The Hanford Site is now committed to an ambitious environmental cleanup mission.

CONTENTS

Section	Page
1 Highlights	1
2 <i>Feature Article</i> – Fostering Partnerships the S&T Way: EMSP Workshops Bring Together Top Scientists and Cleanup Projects.....	5
3 <i>Feature Article</i> – Contaminant Inventory Project: Hanford’s First Top 10	8
4 Integration Project Status Update.....	11
Project Overview and Budget	11
Fieldwork	15
Integration of Information.....	20
System Assessment Capability	22
Science and Technology	24
Technical Review	26
Public Involvement	28
5 For More Information	30
Appendix A: Tactical Project Linkages.....	A-1

ACRONYMS

BHI	Bechtel Hanford, Inc.
CD	Compact Disc
CHG	CH2M Hill Hanford Group, Inc.
CHI	CH2M Hill Hanford, Inc.
CS	Chemical Sewer
DOE	U.S. Department of Energy
DQO	Data Quality Objectives
Ecology	Washington State Department of Ecology
EEG	Environmental Engineering Group
EMSL	Environmental Management Science Laboratory
EMSP	Environmental Management Science Program
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
FEP	Features, Events, and Processes
FH	Fluor Hanford, Inc.
FY	Fiscal Year
HAB	Hanford Advisory Board
HEIS	Hanford Environmental Information System
HFEP	Hanford Site Features, Events, and Processes
HQ	Headquarters
ILAW	Immobilized Low-Activity Waste
IPEP	Integration Project Expert Panel
ISRM	In Situ Redox Manipulation
LANL	Los Alamos National Laboratory
NAS	National Academy of Sciences
ORP	Office of River Protection
PA	Performance Assessment
PITT	Partitioning Interwell Tracer Test
PNNL	Pacific Northwest National Laboratory
PW	Process Waste
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
REDOX	Reduction-Oxidation
RL	Richland Operations Office
RPP	River Protection Project
S&T	Science and Technology
SAC	System Assessment Capability
SIM	Soil Inventory Model
SSRL	Stanford Synchrotron Radiation Laboratory
<i>Tri-Party Agreement</i>	<i>Hanford Federal Facility Agreement and Consent Order</i>
TW	Tank Waste
URL	Uniform Resource Locator
WIDS	Waste Information Database System
WIPP	Waste Isolation Pilot Plant

Section 1

HIGHLIGHTS

PROJECT PURPOSE

Beginning in 1943 and continuing for nearly 50 years, the work conducted at the Hanford Site in southeastern Washington State was an integral part of the nation's defense production efforts. The Hanford Site was established to produce plutonium as part of the Manhattan Project during World War II. The remote, 586-square-mile site was chosen for its abundant supplies of electricity and water from the Columbia River. Eventually, nine plutonium production reactors, five processing facilities, and a nuclear fabrication facility were built and operated.

During the years of the Hanford Site defense production, significant amounts of wastes were created. More than 400 billion gallons of water containing waste products were disposed directly to the soil, an accepted waste management practice of the time. Some of the waste material has reached the groundwater, which ultimately flows into the Columbia River. Nearly 54 million gallons of high-level radioactive and chemical wastes remain in 177, aging, underground storage tanks – 67 of which may have leaked more than one million gallons of waste into the soil.

Today, the U.S. Department of Energy (DOE) is responsible for the management and cleanup of the Hanford Site. The DOE, through its Richland Operations Office, has an ambitious vision for the Hanford Site.

The vision has three strategies, or goals. The first is to restore the Columbia River corridor to ensure that this vital resource is available for future generations. This corridor includes the southwestern portion of the Hanford Site bordering the Columbia River. The second is to prepare a section of Hanford for long-term waste management. The facilities on Hanford's Central Plateau were used to separate the uranium and plutonium from the irradiated nuclear fuel, and this part of Hanford will require monitoring and maintenance for at least 40 years. The final goal is to prepare for the future by defining the approach

and guiding principles Hanford will use to support the local community's efforts toward economic diversification.

To achieve the DOE vision, many different projects are underway at the Hanford Site to characterize, monitor, and clean up the radioactive and chemical contaminants in the groundwater and the vadose zone – the soil between the ground surface and the groundwater – beneath the site. In 1997, DOE recognized the need to integrate these projects.

As a result, the Groundwater/Vadose Zone Integration Project (Integration Project) was established. The primary goal of the Integration Project is to provide a sound technical basis to inform and influence cleanup decisions. By coordinating and integrating a wide range of activities, the Integration Project is dedicated to characterizing and monitoring contaminants in the vadose zone and groundwater beneath the Hanford Site.

The Integration Project has two other objectives. The first is to develop computer-based models that will provide an understanding of the distribution, movement, and impacts of the contaminants on the many users of the Columbia River. The second is to apply new science and technology (S&T) into ongoing cleanup activities and sharing that information with all of the Hanford Site projects. A critical element of the Integration Project's success is its management approach that involves openness and public involvement, coupled with reviews by technical experts.

Since the inception of the Integration Project, there have been numerous noteworthy accomplishments. Summaries of a few recent accomplishments follow.

- Over the years, many of the tanks on the Hanford Site used to store radioactive and chemical wastes have leaked, causing concern about the movement of these contaminants into the groundwater. To begin to provide

Section 1 – Highlights

information to address this concern, the first-ever drilling of a borehole directly beneath an underground storage tank at Hanford was completed. The results of the sample analyses are providing valuable information about the types and amounts of contaminants under the tanks and the extent to which they have moved through the soil. So far, the waste components appear to be distributed through the sediments under the tank in patterns consistent with the ways scientists expected the wastes to interact with soil components.

- The In Situ Redox Manipulation (ISRM), a groundwater remediation technology, was developed and implemented to prevent a toxic form of chromium from reaching the Columbia River where it could harm young Chinook salmon. The ISRM process works by injecting chemicals into the groundwater, creating a permeable treatment barrier. As the chromium passes through the barrier, it is converted to a form that is insoluble in water and much less toxic to young salmon.
- A Hanford Sitewide S&T roadmap was developed to link cleanup needs with S&T programs. This roadmap is used to plan and implement work to address scientific and technical challenges faced by the Hanford Site in assessing and cleaning up soil and groundwater contamination. The tool was developed through a series of meetings that included representatives from DOE's national laboratories, site remediation contractors, regulators, tribal nations, and local stakeholders.

These accomplishments demonstrate the diverse range of activities that have been completed by the Integration Project team. However, the efforts of the Integration Project team do not stop here. This, the fifth semi-annual report, provides a review of the work coordinated through the Integration Project for the first half of fiscal year 2001 (FY01): October 1, 2000 through March 30, 2001.

FEATURED IN THIS REPORT

Two articles are included in this report. The first article, "Fostering Partnerships the S&T Way," describes how calls for research proposals related to resolving Hanford's vadose zone contamination problems were designed to link with ongoing cleanup projects. The DOE's Environmental Management Science Program (EMSP) issued the calls and collaborated with the Integration Project S&T managers to produce this new approach.

The second article, "Contaminant Inventory: Hanford's First Top 10," discusses the locations, types, and quantities of waste across the site and the challenges in gaining an accepted understanding of the waste "inventory." The "top 10" contaminants in this first assessment were selected based on their risk to human health and the environment.

In addition to these articles, the work of the Integration Project team during the past six months is described in this report. A summary of these activities follows.

INTEGRATION PROJECT HIGHLIGHTS

Fieldwork. The Integration Project serves as a focal point for all Hanford Site projects that address cleanup of the site's subsurface, including projects involving the vadose zone and groundwater monitoring, characterization, and remediation. Key fieldwork accomplishments during the reporting period are summarized below.

Fifteen new groundwater monitoring wells were installed to comply with requirements of the *Resource Conservation and Recovery Act of 1976* (RCRA). The 2000 Groundwater Monitoring Report for the Hanford Site (PNNL-13404) describes the groundwater conditions at the Hanford Site and provides a summary of vadose zone investigations.

Section 1 – Highlights

Ten new wells were installed within the ISRM barrier. This barrier helps prevent a chromium plume from reaching the Columbia River and endangering young salmon.

Efforts began to characterize the soil at two waste groups in the 200 Area Central Plateau where tank wastes were discharged to the ground during past operations. Soil characterization also began at the BX Tank Farm.

Work continued to investigate a significant groundwater tritium plume discovered near the 618-11 Burial Ground (see the map on the inside front cover of this report). Two groundwater samples that were collected north and east of the burial ground are helping to refine knowledge about the extent of the tritium plume. A sampling and analysis plan has been developed and is awaiting regulatory approval to continue the investigation.

System Assessment Capability (SAC).

A critical element in cleaning up Hanford's subsurface involves developing a comprehensive understanding of the inventory of wastes at the Hanford Site. This inventory must include information about the solid and liquid wastes and facilities on the site; the ways these wastes may move through the environment, such as the vadose zone, groundwater, and Columbia River; and the risks and impacts to humans and the environment from these wastes. The SAC is a set of databases, models, and related tools being designed to provide this information.

The key accomplishment related to the SAC during the reporting period involves "history matching." This work began in March and involves comparing the SAC model outputs to field observations of wastes on the Hanford Site. In cases where field observations were not available, comparisons were made to results from previous assessments. This data matching work will allow scientists to gauge how well the SAC can provide accurate information about wastes at the Hanford Site.

Integration of Information. A wealth of technical data and information about the Hanford Site has been (and continues to be) created by the many projects underway to cleanup the site. This knowledge must be well integrated, effectively managed, and easily accessible to be of value to a wide range of users.

A major objective of this activity is to prepare datasets, interpret data, and create conceptual models that best describes the understanding of the Hanford Site. The database that documents the initial identification and screening of the features, events, and processes that are technically relevant to Hanford Site assessments began operating in January. This work supports the SAC.

Science and Technology. The goal of this work is to provide new knowledge, data, and tools for cleaning up and managing the Hanford Site. This includes promoting new technologies and research that is focused on improving the scientific basis for decisions to protect the Columbia River and its ecological systems. Summaries of key accomplishments during the reporting period follow.

A Soil Inventory Model was developed to generate detailed estimates of waste contaminants that spilled or leaked from single-shell tanks at the Hanford Site. The model also provided estimates for several waste sites in the 200 Area Central Plateau, where high-volume liquid wastes were discharged into the soil. This work supports the SAC.

Preparations for injecting saline fluids at the Vadose Zone Transport Field Study site in the 200 East Area were completed, as were S&T investigations supporting the S-SX Tank Farm fieldwork. These investigations included laboratory experiments with contaminated and uncontaminated soil samples and advanced modeling studies.

A second workshop on Hanford S&T research was held in November for the principal investigators who receive support from the DOE EMSP research grant program.

Section 1 – Highlights

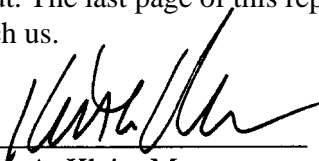
Technical Review and Public Involvement.

Rigorous technical reviews of the scientific merit, technical content, and managerial leadership of the Integration Project are essential for its success. Equally important to these reviews are opportunities for members of the public to share information and views about the project's activities. Together, these efforts are helping to build the mutual trust and support needed to move forward toward Hanford Site cleanup. Key accomplishments during the reporting period follow.

During their October meeting, the Integration Project Expert Panel (IPEP) focused on the Columbia River and restoring the river corridor. These meetings give stakeholders, tribal nations, and regulators an opportunity to express their views and interact with the panel members.

The final three meetings of the National Academy of Sciences (NAS) study committee on environmental remediation S&T at the Hanford Site were held in October, January, and March. The release of a summary report is expected in the summer of 2001.

The Integration Project is a work in progress. If you have questions about this report or the Integration Project, you are invited to become involved in the project and provide us with your input. The last page of this report tells how to reach us.



Keith A. Klein, Manager
U.S. Department of Energy
Richland Operations Office

Section 2 – FEATURE ARTICLE

FOSTERING PARTNERSHIPS THE S&T WAY:

EMSP WORKSHOPS BRING TOGETHER TOP SCIENTISTS AND CLEANUP PROJECTS



PNNL's Bob Peterson provides workshop participants with an overview of the Hanford Site, from Gable Butte.

FOSTERING PARTNERSHIPS THROUGH CONSTRUCTIVE DIALOGUE

In November 1999, a workshop at the Environmental Management Science Laboratory (EMSL), which is part of the Pacific Northwest National Laboratory (PNNL), brought together scientists and Hanford staff to encourage dialogue and find ways to work together to solve Hanford Site cleanup problems. At the workshop, nationally recognized scientists who had won basic research grants through the highly competitive Environmental Management Science Program (EMSP) joined with engineering and technical leaders from various Hanford Site cleanup projects. The EMSP scientists came in hopes of making their research results more applicable and useful. Hanford personnel responsible for onsite cleanup projects were, in turn, looking for new scientific knowledge and

improved technical know-how. This workshop, along with another held in November 2000, provided an effective mechanism to establish productive collaborations between these two groups. This article looks at how these workshops began, and what the resulting partnerships have achieved so far.

APPLIED AND BASIC RESEARCH

The EMSP workshops represent a new tool for introducing S&T into environmental operations at Hanford and other DOE cleanup sites. The EMSP, which was established in 1995, is DOE's principal program for funding ***basic research*** to support environmental management. Research program managers, whether in government or the private sector, often struggle with finding the right balance between basic research and ***applied research***. Basic research focuses on fundamental questions or technical issues, while applied

Section 2 – Fostering Partnerships the S&T Way

research focuses on solving specific cleanup problems. Most scientists agree that basic and applied research are both necessary and are often mutually beneficial.

Too much direction that is narrowly focused on specific problems can undercut the necessary growth in a fundamental understanding from which breakthrough discoveries and revolutionary new technologies may emerge. At the same time, it is often difficult to justify the expenditure of scarce research funds to expand fundamental understanding without clear answers to pressing problems. To provide this balance, the EMSP uses a two-phase evaluation process in selecting projects to support. Grant applications are first rated for scientific merit (selecting “the best science”). Then, a separate panel rates the applications for relevance to DOE environmental management needs. To win, a grant application must score well with both panels.

The innovation added by the Integration Project workshops has been to bring new principal investigators to the Hanford Site *after their selection* for a three-year award, in order to facilitate direct communication with the people engaged in the actual problems of Hanford cleanup. The workshops encourage, but do not force or direct, EMSP investigators to find ways to make their research more relevant to those problems.

The concept for the first workshop began to take shape in November–December of 1998, through discussions among the director of the EMSP, the S&T staff at the DOE office in Richland, and Integration Project leads. The announcement of a research area in which the EMSP will make awards is known as a “call” for grant applications. These initial discussions revolved around a planned call for “basic research in all areas of science with the potential for addressing problems in subsurface contamination and transport processes in the vadose (unsaturated) zone.”

This call was guided by the Hanford S&T plan and roadmap, which were developed by the Integration Project in FY99. The plan and roadmap documented needs for scientific

knowledge and improved technologies to address Hanford subsurface contamination.

Planning for a first “kickoff” workshop, to be held in November 1999, continued in parallel with the EMSP call and selection process. From the beginning, the workshop organizers aimed to create access, in both directions, between the EMSP investigators and the onsite cleanup contractors. The guiding principle was to interest each side in what the other could offer. In September, shortly after the EMSP awards for the year were announced, information about the workshop was sent to the principal investigators for the 31 projects selected under the “subsurface contamination in the vadose zone” call. Attendance by a senior investigator from each research project team was required by the grant for this first meeting.

COORDINATION AND LINKAGES ESTABLISHED

The first three-day workshop in November 1999 included presentations by Integration Project staff, other site cleanup contractors, and EMSP investigators, as well as a tour of the Hanford Site.

Practical benefits immediately resulted from the workshop, as the EMSP projects focused on research relevant to Hanford Site cleanup. A number of the projects began to focus on investigations relevant to the Tank Farm Vadose Zone Characterization Project (part of the River Protection Project [RPP]). These projects were provided with contaminated and uncontaminated soil samples retrieved from the S-SX Tank Farm. Several of the EMSP projects focused on resolving issues involving cesium-137 transport, which has been a controversial topic at Hanford. These projects performed laboratory experiments that have improved Hanford’s ability to explain past cesium-137 migration in the vadose zone, and to predict future transport.

Other EMSP projects investigated samples contaminated with chromium, which is a mobile contaminant that exists in several chemical forms. These studies demonstrated that the inventory of potentially mobile and hazardous chromate in the

Section 2 – Fostering Partnerships the S&T Way

vadose zone could be transported to the groundwater.

The EMSP investigations of cesium-137 and chromium at the S-SX Tank Farm were performed at three DOE facilities: (1) the Environmental Molecular Sciences Center (EMSL), at PNNL; (2) the Advanced Photon Source (APS), at Argonne National Laboratory; and (3) the Molecular Environmental Science Beamline, at the Stanford Synchrotron Radiation Laboratory (SSRL). The Hanford soil samples were the most radioactively contaminated samples ever evaluated at these facilities. All soil samples were transported to these facilities, analyzed, and then returned safely to Hanford for disposal without incident.



PNNL's Environmental Molecular Science Laboratory.

EMSP project investigators are also participating directly in vadose zone transport field studies that are funded through the Integration Project S&T program. In these studies, dilute and saline fluids are being injected into the subsurface. Moisture and tracer plumes are then characterized and tracked, using different innovative subsurface geophysical methods. The preliminary results from these field experiments have demonstrated that subtle changes in sediment texture can induce lateral spreading of moisture plumes and contaminants in the vadose zone. The subtle changes in sediment texture may be more important in vadose zone transport than previously thought.

A STRONG FOLLOW-THROUGH AT THE SECOND WORKSHOP

Although attendance at the November 2000 workshop was not mandatory, investigators from most of the FY99 EMSP projects readily participated. The growing significance of the workshops was clear from the increased interest from other EMSP projects and Hanford Site staff. The second workshop included more working sessions than the first.

Chester Miller, an EMSP manager from DOE Headquarters (HQ), has attended both workshops and recently gave this assessment of their value: "This was the first EMSP call that focused on subsurface and vadose zone issues at the Hanford Site. The workshops have been critical to the success of this part of our grant portfolio. The depth and breadth of the interactions between EMSP investigators and those working on Hanford Site cleanup projects was evident at the second workshop. A lot of information was exchanged, and I could feel the excitement about the progress being made."

As time passes, the Integration Project team expects the excitement—and the flow of benefits from the EMSP call and the onsite workshops—to continue and expand. This successful collaboration is another indicator of the value of science integration within Hanford and throughout the DOE complex.

Section 3 – FEATURE ARTICLE

CONTAMINANT INVENTORY PROJECT:

HANFORD'S FIRST TOP 10



Inventory information about waste products like those disposed to the Gable Mountain Pond, shown here as it appeared when cooling waters were discharged during Hanford's active operations, will help scientists to develop cleanup options.

For a successful site cleanup, answers need to be generated for the following questions: “What are the amounts, types, and locations of the radioactive and chemical contaminants produced at Hanford or imported to Hanford?” And: “What will happen to all of Hanford’s wastes, following completion of planned tank waste recovery, vitrification, and remedial actions?”

To answer these questions, a site-wide contaminant “inventory” is being developed under the direction of the Integration Project. Answering the contaminant inventory questions will enable cleanup project managers and scientists to better understand and develop cleanup options to reduce the impact of contamination on groundwater, the Columbia River, and its many users. This

inventory information is an integral part of the SAC (Rev. 0), and is useful to other Hanford projects.

The first phase of the Integration Project’s evaluation of inventory is limited to 10 radioactive and chemical contaminants. These 10 contaminants

10 HANFORD CONTAMINANTS WASTE CONSTITUENTS IN THE SAC (REV. 0) INVENTORY	
Radiological Hazards tritium technetium-99 iodine-129 uranium-238 strontium-90 cesium-137 plutonium-239/240	Chemical Hazards carbon tetrachloride chromium total uranium

Section 3 – Hanford’s First Top 10

were selected on the basis of their risk to human health and the environment, and the different rates at which they move through the vadose zone and groundwater. Using this inventory, the Integration Project will assess contaminant impacts. The inventory includes the quantity, distribution, and location of each contaminant.

“One of the Integration Project’s goals is to balance our inventory account,” said Dr. Charley Kincaid. “This means we are able to determine what was brought onsite, what was created onsite, and what left the site. With this information we balance our inventory, much like one would balance a checkbook.”

THE COMPLEXITY CHALLENGE

The detailed accounting of how much of a contaminant is present at a moment in time and point in space can be quite complex. A “moment in time” and “point in space” portrait of Hanford’s inventory involves a waste site-by-waste site approach. Accumulated over the period of Hanford Site operations, the waste-site inventories can provide an estimate of total inventory. Complementing the waste-site approach to total inventory is a top-down estimate of the total contaminant inventory generated by the irradiation of fuel in Hanford Site reactors. The uncertainty in the “reactor generated” total inventory model is inherently less than that in the “waste-site” total inventory. By performing both types of accounting, a “mass balance” is produced for each contaminant. For radiological constituents, the rate of radioactive decay must be taken into account, because it decreases the amount of material over time, while producing other contaminants as decay products. For chemical contaminants, the challenge is to find the amount of contaminant imported, produced, consumed, or moved offsite (exported).

INVENTORY DETECTIVES

Mike Coony of Fluor Hanford, Inc. (FH) is a member of the Integration Project who is working to collect, interpret, and process data from 890

waste sites where radioactive and hazardous chemical wastes are present. Data and information from a variety of sources are being used by Coony and others to develop the contaminant inventory, including site project databases, computer modeling results, production records, process logs, activity reports, and interviews with current and former employees.

Some of these information sources provide detailed information on the amount and location of such waste forms as spent fuel, the material in waste tanks, and irradiated materials left in the reactor cores.

Conversely, some waste cannot be accounted for in existing records, which makes it very hard to complete an inventory for the 10 preliminary contaminants. These waste forms include material discharged to some cribs, trenches, ponds, and wells, along with several unplanned environmental releases resulting from leaks and spills.

To begin a site-wide contaminant inventory, researchers pieced together and documented the volume and composition of waste at 890 locations across the Hanford Site. By reviewing those waste sites with known volumes and inventory data, researchers can estimate the waste compositions at sites for which historical volume and inventory estimates are incomplete. Where a complete absence of volume and inventory data existed, waste site information captured in Hanford’s Waste Information Database System (WIDS) was used to identify waste stream sources and surrogate waste sites to help researchers document their assumptions and estimate that inventory.

COORDINATION AND COMMUNICATION

The day-to-day work of constructing histories of waste disposal operations for individual locations has resulted in close cooperation between various Hanford projects. For example, the RPP is responsible for characterizing the waste contaminants in the vadose zone within the tank farm boundaries, which resulted primarily from unplanned spills and leaks from tanks. On the

Section 3 – Hanford’s First Top 10

other hand, the 200 Area Waste Site Assessment project is responsible for the locations outside the tank farms (where planned releases of liquid wastes were discharged to the ground). Both teams need to know about the same process conditions and process streams, because the disposal systems are the same. Documents and records that one Integration Project “inventory detective” finds useful are often of value to counterparts on other project teams. In this way, informal and efficient routines for sharing information continue to evolve as new sources and new issues emerge.

The day-to-day sharing of information is already contributing to the **current** work on several cleanup projects. The core projects and the Integration Project S&T staff are now sharing a standard set of waste stream definitions. Each definition includes details of the stream composition, and ties it to a particular process and specific operating periods during the production years. As the “inventory detectives” uncover new information about a waste stream, and as new and improved inventory estimates are generated, the supporting information and references will be incorporated in the WIDS (a database available to all Hanford projects). The original sources of the information going into WIDS are documented, so the origins of this shared knowledge can be traced, and so that conflicting information can be evaluated collectively to continuously improve waste stream definitions.

Integration Project members reflect the multiple contractors and projects who are at work at the Hanford Site. In addition to Mike Coony (FH), communication and collaboration on inventory issues and estimates has involved the following personnel:

- Michelle Yates (CH2M Hill Hanford, Inc. [CHI]), working on inventories for waste sites in the 200 Areas
- Tom Jones (CH2M Hill Hanford Group, Inc. [CHG]), working on inventories for past tank leaks

- Rob Corbin (Los Alamos National Laboratory [LANL]) and Brett Simpson (CHG) who have developed the Soil Inventory Model and inventories for a number of significant liquid discharge and tank leak sites.

Future improvements to the inventory estimates are being prepared under the leadership of Lou Soler (Bechtel Hanford, Inc. [BHI]), who is part of the Integration Project team.

A “LIVING” INVENTORY

As Integration Project work continues, more contaminants will be added to the inventory database. The ultimate goal is to have a “living” database that is constantly updated to reflect improved knowledge of contaminant location and quantity, and the latest remediation plans.

The current contaminant inventory is being incorporated into the SAC. This computer model will help assess the cumulative impacts of Hanford-derived contaminants on the Columbia River and its users.

“Assessments performed with the SAC will provide useful insight about the future impacts of Hanford’s contaminants on the Columbia River and the region,” says Bob Bryce, of PNNL. Bob is the SAC lead for the Integration Project. A reliable contaminant inventory for the Integration Project is a key element in completing the assessment.

Important as they are, the initial 10 contaminants that are being produced for SAC (Rev. 0) are only a first step. Work is already in progress towards expanding the list of radiological and chemical contaminants in the inventory’s location-specific database.

Section 4

INTEGRATION PROJECT STATUS UPDATE

PROJECT OVERVIEW AND BUDGET

The Integration Project Endeavors and Core Projects

The DOE established the Integration Project in late 1997 as its centerpiece for near-term and long-term water resources protection. The purpose of the Integration Project is to inform and influence cleanup decisions at the Hanford Site by assessing the risks and effects of the site's activities upon the many users of the Columbia River. The Integration Project, by teaming with the "core projects," has implemented a coordinated and cohesive approach to this scope of work.* The Integration Project also added elements that, in the past, were either lacking or under-emphasized (e.g. Science & Technology and Technical Review). The result is an integrated site-wide strategic approach that is effectively focused on Hanford's most pressing near- and long-term cleanup priorities.

FY01 funding for the Integration Project, as managed by RL, totaled \$10.83 million. The related "core" projects received a total of \$43.14 million in FY01. Both RL and the Office of River Protection (ORP) are responsible for the oversight of the core projects (see the project budget summary table on page 11).

The success of the Integration Project depends on site-wide cooperation between the various contractors participating in its activities, and on the core fieldwork projects. To help coordinate these site-wide efforts to protect the Columbia River, the Integration Project has developed six *endeavors*.

The six endeavors are as follows:

- Fieldwork (coordinating and integrating the work performed by the core projects)
- Site-wide Integration of Information (annual work planning, technical information management and data sharing, etc.)
- System Assessment Capability
- Science and Technology
- Technical Review
- Public Involvement.

The status reports in the remainder of this section are organized according to these endeavors. During the current reporting period (October 2000 to March 2001), a substantial shift in work phases has occurred. Many Integration Project activities have now moved from initial planning tasks to project deployment, and these activities are now producing useful results

Funding

The project budget summary table (page 11) shows actual funding for FY00 and FY01. Planning continues for FY02.

* At the Hanford Site, as with most complex waste management and cleanup endeavors, there are multiple projects and organizations responsible for various aspects of the overall site mission. Existing projects whose primary scope involves environmental characterization and monitoring, or risk and performance assessments, are termed **core projects**.

Section 4 – Integration Project Status Update

Funding for the Integration Project and Core Projects by Fiscal Year.
(millions of dollars)

	FY 2000 Funding	FY 2001 Funding	Responsible DOE Office^a
<i>System Assessment Capability</i>	\$2.85	\$2.36	RL
<i>Science and Technology</i>	\$4.70	\$4.90	RL
<i>Technical Review</i>	\$0.99	\$0.60	RL
<i>Public Involvement</i>	\$0.33	\$0.29	RL
<i>Integration of Information</i>			
Project Management	\$0.83	\$0.46	RL
Data Management and Issues Resolution	\$1.62	\$2.22	RL
Integration of Information Subtotal	\$2.45	\$2.68	
Integration Project, Total Funding	\$11.32	\$10.83	
<i>Core Projects (Fieldwork)</i>			
Groundwater and Vadose Zone Monitoring	\$11.66	\$12.66	RL
Well Installation and Maintenance	\$0.72	\$1.85	RL
River Protection Project Vadose Characterization	\$7.11	\$9.00	ORP
Tank Farm Geophysical Logging	\$1.08	\$1.50	ORP
ILAW Characterization	\$2.04	\$2.10	ORP
ILAW Performance Assessment	\$0.46	\$0.30	ORP
Columbia River Monitoring	\$0.39	\$0.40	RL
200 Area Waste Site Characterization	\$3.53	\$4.90	RL
100 Area Pump and Treats (HR, KR, NR)	\$5.35	\$7.36	RL
200 Area Pump and Treats (UP, ZP)	\$1.51	\$1.78	RL
200 ZP Vapor Extraction	\$0.25	\$1.29	RL
Core Projects, Total Funding	\$34.10	\$43.14	
Integration Project and Core Projects, Total Funding	\$45.42	\$53.97	
<i>Headquarters Programs</i>			
Environmental Management Science Program (\$25 M over FY 2000 - FY 2002)	\$10.00	\$10.00	HQ
Total Funding, All Activities in Status Report	\$55.42	\$63.97	
^a RL = DOE Richland Office ORP = DOE Office of River Protection HQ= DOE Headquarters (Office of Environmental Management)			
Note: The budget table in previous issues of this report included a separate line for Cone Penetrometer Development and Demonstration. The cone penetrometer (also called "direct push") technology was successfully demonstrated in soil characterization work inside the tank farms (see May 2000 Semi-Annual Report), and the technology is now among the tools used for characterization work on site.			

Section 4 – Integration Project Status Update

LINKAGES: THE PATH FORWARD

The Integration Project is linked to Hanford Site decisions and issues both tactically and strategically. From the inception of the Integration Project, working partnerships have been established with the core projects to help determine gaps in their technical baselines. The S&T Roadmap and other Integration Project tasks were defined to fill these gaps in the time frame required for core project commitments and decisions. In addition, the Integration Project has been at the center of strategic planning for the Hanford Site. Outputs from the Integration Project are aligned with DOE's vision of transitioning the Central Plateau for long-term waste management, and with the DOE focus to clean up the River Corridor.

Tactical Linkages. Tactical linkages to Hanford milestones have been accomplished through partnerships with the core projects. These tactical linkages require interdependence between the core projects and the Integration Project team. This interdependence is enabled by co-location of key staff, and utilization of and adherence to a disciplined project management approach. In other words, co-location enables the communications that define and refine requirements and expectations. Project management tools formalize agreements. A summary of the key tactical linkages is shown in Appendix A: Tactical Project Linkages.

Strategic Linkages. The decision framework for achieving the Hanford vision is not entirely in place. Along the River Corridor there are regulatory decisions in place for soil and waste site cleanup. Final decisions for groundwater remediation cannot be made until better treatment technologies are developed and implemented.

For the Central Plateau, the situation is much more complex. Unlike the Waste Isolation Pilot Plant (WIPP) and Yucca Mountain projects, clear performance requirements are not established for Central Plateau cleanup. However, the Integration Project has developed an overall strategy to provide the information needed to define the parameters for operating the Central Plateau as a

waste management area. This strategy is based on integrated field characterization, focused S&T, a consistent approach to data interpretation and integration, and the SAC. From its inception, the Integration Project has worked to achieve a balanced portfolio of field data, science and technology, and modeling.

The Integration Project has implemented an integrated approach to field characterization in the 200 Area Central Plateau. Changes have been incorporated in the *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement)* in order to align the work scope for the 200 Area Waste Site Assessment, the assessment of leaks from single-shell tanks, and related groundwater remediation work. By 2003, initial characterization will be complete for the most dangerous of the past practice sites, as well as the single-shell tank farms that have impacted groundwater. This characterization will provide a significant body of new information and insights on the sources and distribution of contaminants in the Central Plateau. Other monitoring and characterization efforts (e.g., the borehole geophysical logging program, the groundwater remediation and monitoring program, etc.) contribute to this baseline of information.

The S&T Roadmap is well aligned to support and enhance characterization and assessment work (as described above under tactical linkages). This includes providing scientific fieldwork, laboratory experiments, advanced modeling, and improved inventory estimates. These efforts, in combination with other long-term research activities, are designed to also address the broader needs of the SAC.

The S&T program, through the roadmap process, is providing research results on a schedule to support the core projects and the SAC through the 2003/2004 time frame. The results of the EMSP projects will be published in this same time frame.

The Integration of Information task is responsible for integrating and locking down site-wide information in a consistent and retrievable format. Data packages incorporating the new information from characterization and S&T will be completed

Section 4 – Integration Project Status Update

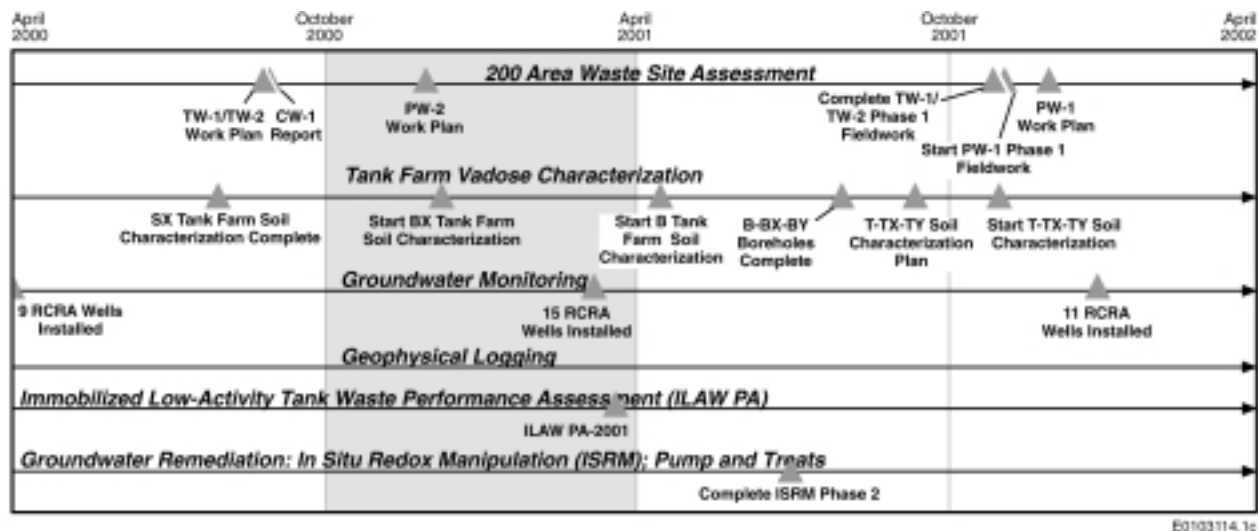
in 2004. The SAC capability will be applied over the next few years to support the evaluation of alternatives to the current cleanup plan. Through these applications and regulatory negotiations, the requirements for the SAC (Rev. 1) will be established in 2003. Development of the SAC (Rev. 1) will follow with a target date of completion in 2004.

In summary, the Integration Project is tactically aligned to support the commitments of the core projects, and strategically aligned to support the Hanford Site vision. The project is promoting groundwater remediation technology development, and is providing information to support River Corridor and Central Plateau objectives. Through an integrated and balanced approach linking field characterization, science and technology, and modeling, the DOE and the Integration Project will establish an integrated remediation baseline and will take an important step in transitioning the Central Plateau for long-term waste management.

Section 4 – Integration Project Status Update

FIELDWORK

(Vadose Zone and Groundwater Monitoring, Characterization, and Remediation)



The two projects that have the primary responsibility for performing fieldwork to characterize contaminated soil sites in the Central Plateau are the 200 Area Waste Site Assessment Project and the Tank Farm Vadose Zone Characterization Project. To be successful at remediating and closing waste sites in the Central Plateau, the characterization work performed by the two projects must be integrated. The formation of the Integration Project and the co-location of staff from these projects has helped to ensure that fieldwork is performed in concert.

The 200 Waste Site Assessment Project is responsible for characterizing and remediating over 800 waste sites that are located in the 200 East and 200 West Areas of the Hanford Site. The waste sites have been placed into 23 groups (called “operable units”) in order to provide focus and streamline fieldwork.

The Tank Farm Vadose Zone Characterization Project performs fieldwork to collect the information needed to determine cleanup options in and around underground waste storage tanks. Storage tanks were grouped together for operations into “farms.” Past releases of dangerous waste and dangerous waste constituents from some of the single-shell tanks have resulted in groundwater contamination, which has

triggered the establishment of *Tri-Party Agreement* milestones to accelerate characterization. Milestones have been set up for the S-SX, B-BX-BY, and T-TX-TY Tank Farms.

In FY99, a unique integration opportunity was recognized to coordinate the characterization of two operable units that contain sites that received tank farm-related wastes: scavenged waste sites (TW-1) and tank waste sites (TW-2) with characterization work at the B-BX-BY and T-TX-TY Tank Farms. The operable units were not scheduled for characterization until after FY00. The milestones for fieldwork at these operable units were renegotiated with the regulators to coordinate with tank farm milestones. Integration activities between the projects include conducting joint data quality objective (DQO) workshops, coordinating sampling activities and analytical requirements, and ensuring that all data are available in a form usable by both projects.

Integration efforts have not been limited to these two projects. Schedule adjustments continue to be made to improve coordination with other projects, such as RCRA well drilling, the groundwater monitoring program, the geophysical logging program, the immobilized low-activity waste performance assessment (ILAW PA), groundwater remediation activities using ISRM,

Section 4 – Integration Project Status Update

and ongoing groundwater pump-and-treat operations.

TIMELINE AND KEY MILESTONES

Note: Items that appear in bold, below, are “keyed” to match milestones presented in the timeline (above) for this section.

Milestones met during the reporting period include delivery of a work plan for initial characterization of sites that received uranium-rich process wastes (**PW-2 Work Plan**), the start of work on soil characterization inside the BX Tank Farm (**Start BX Tank Farm Soil Characterization**), and installation of 15 additional monitoring wells to comply with RCRA (**15 RCRA Wells Installed**). During March, a second characterization borehole for the ILAW PA was drilled and sampled (**ILAW PA 2001**).

Upcoming milestones for the 200 Area Waste Site Assessment include the following:

1. Submission by the end of December 2001 (rescheduled from June 2001) of a work plan for characterization of organic- and plutonium-rich waste sites (**PW-1 Work Plan**).
2. Completion in October 2001 of Phase 1 field characterization for the tank farm-related waste sites (**Complete TW-1/TW-2 Phase 1 Fieldwork**).
3. Startup of field characterization of the organic- and plutonium-rich waste sites (**Start PW-1 Phase 1 Fieldwork**) in early November 2001.

Upcoming milestones for the Tank Farm Vadose Zone Characterization Project include startup of **B Tank Farm Soil Characterization** in April 2001, and completion of boreholes for characterization of the B-BX-BY Tank Farms in August 2001 (**B-BX-BY Boreholes Complete**). Submission of **T-TX-TY Soil Characterization Plan** for regulatory approval is scheduled for September 2001. The **T-TX-TY Field**

Investigations are expected to begin in November 2001.

The continuing activities for **groundwater monitoring, geophysical logging**, and the **ILAW PA** are represented by straight lines through the time periods shown on the timeline. By the end of December 2001, an additional 11 monitoring wells for RCRA compliance are planned (**11 RCRA Wells Drilled**).

Also shown as straight-line activities are the operations in the 100 and 200 Areas for pumping groundwater at the leading edge of the plumes, and treating the groundwater to remove contaminants, as well as the **ISRM** barrier for the chromium plume west of the 100 D area. The 28 additional injection wells and 4 new compliance monitoring wells for Phase 2 of the ISRM barrier are scheduled for completion in June 2001, with injection of 24 wells by September 30, 2001 (**Complete ISRM Phase 2**).

SIGNIFICANT EVENTS THIS PERIOD

200 Area Waste Site Assessment Project. The **PW-2 Work Plan** was submitted on schedule in December 2000. Characterization fieldwork began for the TW-1 and TW-2 waste groups, and will continue throughout the next period. Regulatory approval was received to move forward with characterizing waste sites that received organic- and plutonium-rich wastes (PW-1). These sites have contaminated groundwater and pose a continuing risk to degrade water quality. The **PW-1 Work Plan** is currently being developed.

Work that had been planned for this period in characterizing representative sites in the chemical sewers (CS) waste group has been deferred to the spring of 2002, due to budget constraints.

Tank Farm Vadose Zone Characterization Project. Borehole drilling for **BX Tank Farm Soil Characterization** began on October 2, 2000 (ahead of schedule). The borehole reached a planned depth on January 26, 2001, and was decommissioned on March 7. A draft work plan

Section 4 – Integration Project Status Update

for the **T-TX-TY Tank Farm Soil**

Characterization was submitted to the regulators on March 9, 2001. The final plan is scheduled for completion by September 2001.

Tritium at the 618-11 Burial Ground. Results of a soil gas survey conducted in August 2000 indicate that there is a source of tritium associated with the 618-11 Burial Ground. Two groundwater wells were sampled in October 2000 (one from the north side of the burial ground, and the other 80 meters to the east) to help refine the location and extent of the groundwater plume. The tritium value in the sample from the north side was about 5000 pCi/L. The sample from east of the burial ground was 1.5 million pCi/L. A sampling and analysis plan has been developed and is being reviewed by the regulators. The plan continues the investigation to determine the nature and extent of this tritium plume.

Groundwater Monitoring. The *2000 Groundwater Monitoring Report for FY00* (PNNL-13404) was issued in March 2001. The report describes the current groundwater conditions at the Hanford Site, including the distribution of contaminant plumes, the effects of groundwater remediation, and the results of groundwater modeling work. Vadose zone monitoring and characterization work is also summarized in the report to help frame an understanding of potential sources of groundwater contamination. This report, along with the reports for several past years and related technical reports, is available on the Internet at <http://hanford-site.pnl.gov/groundwater/reports>. For a compact disc (CD) version of the report, contact Mary Hartmann, at (509) 373-0028.

All 15 of the additional groundwater wells for monitoring under RCRA were completed by April 2, 2001 (**15 RCRA Wells Installed**). These 15 wells are outside the S-SX-SY and T-TX-TY Tank Farms.

Immobilized Low-Activity Waste Performance Assessment. During March 2001, a second characterization borehole was drilled at the northeast corner of the ILAW disposal site (**ILAW PA 2001**). (The ILAW site is

in the south-central part of the 200 East Area.) Samples were taken from the Hanford sand formation, and the samples are being analyzed to determine hydraulic and geochemical properties of naturally occurring Hanford soils. Little recovery was possible in the gravel formations, but multiple air permeability tests were conducted. These will help in determining the hydraulic conductivity of the formations. Drilling activities began on March 14, and were completed on March 29. The borehole has been converted to a groundwater well, and will become a RCRA monitoring well for the ILAW site.

Groundwater Remediation Projects. To continue the ISRM barrier across the chromium plume west of the 100 D reactors, 10 new wells were installed during this period. Injection and extraction activities to establish the chemical barrier were completed for one well.

All five of the groundwater pump-and-treat remediation systems operated during this period. The run times for these operations increased over FY00 averages.

The soil vapor extraction system for carbon tetrachloride in the 200 Area was not operated during this period. Instead, a passive remediation system (developed at the DOE's Savannah River Site) was installed and tested on a few selected wells. The soil vapor extraction system will be operated again during the second half of FY01.

SIGNIFICANT EVENTS NEXT PERIOD

The 200 Area Waste Site Assessment Project. The anticipated delivery date for the Plutonium Organic Risk Waste Group **PW-1 Work Plan** is December 2001. The major fieldwork activities during this period will focus on characterizing waste sites in the tank waste groups (TW-1 and TW-2). Of the three TW-1/TW-2 sites to be studied, two are near the B-BX-BY Tank Farm. The third is near the T-TX-TY Tank Farm.

Workshops will be conducted in April 2001 with regulators to present the technical basis for

Section 4 – Integration Project Status Update

schedule changes proposed in the schedule options study. This study, which was performed in 2000, sought options for faster restoration of the Columbia River Corridor.* Under the proposed approach, only 12 of the 23 waste groups defined for the 200 Area would undergo initial characterization efforts. The results from these 12 groups would be used as the basis for remediation decisions on all 23 waste groups. If the regulators accept the technical basis, milestones under the *Tri-Party Agreement* will be modified.

Throughout the next period, workshops with the regulators will be conducted to define a range of remediation options suitable for waste disposal sites that extend into the Central Plateau “buffer zones.” Under the current land-use plan for the Central Plateau, the long-term stewardship areas will be closed to civilian use, secured, and controlled to prevent environmental contamination or human exposure. Each of these closed areas will be surrounded by a buffer zone, in which land-use options will be restricted. Some of the waste sites being addressed by the 200 Area Waste Site Assessment Project are located outside the fence line of the controlled area in the buffer zone. These sites include some of the large ponds that received cooling water waste from processing operations, as well as smaller crib and ditch sites. The remediation options inside the controlled areas are close to being defined, but a range of options is needed for use in remediation planning for the buffer zone.

Tank Farm Vadose Zone Characterization Project.

The **B Tank Farm Soil Characterization** effort will begin on schedule in early April 2001. The total depth of boreholes in both the B and BX Tank Farms is expected to be reached in August 2001. Work will continue in the next period on the plan for soil characterization fieldwork inside the T-TX-TY Tank Farms, with submission of the final plan scheduled for September. If the regulators approve the plan,

T-TX-TY Soil Characterization can begin in November 2001.

Groundwater Monitoring and Remediation Projects.

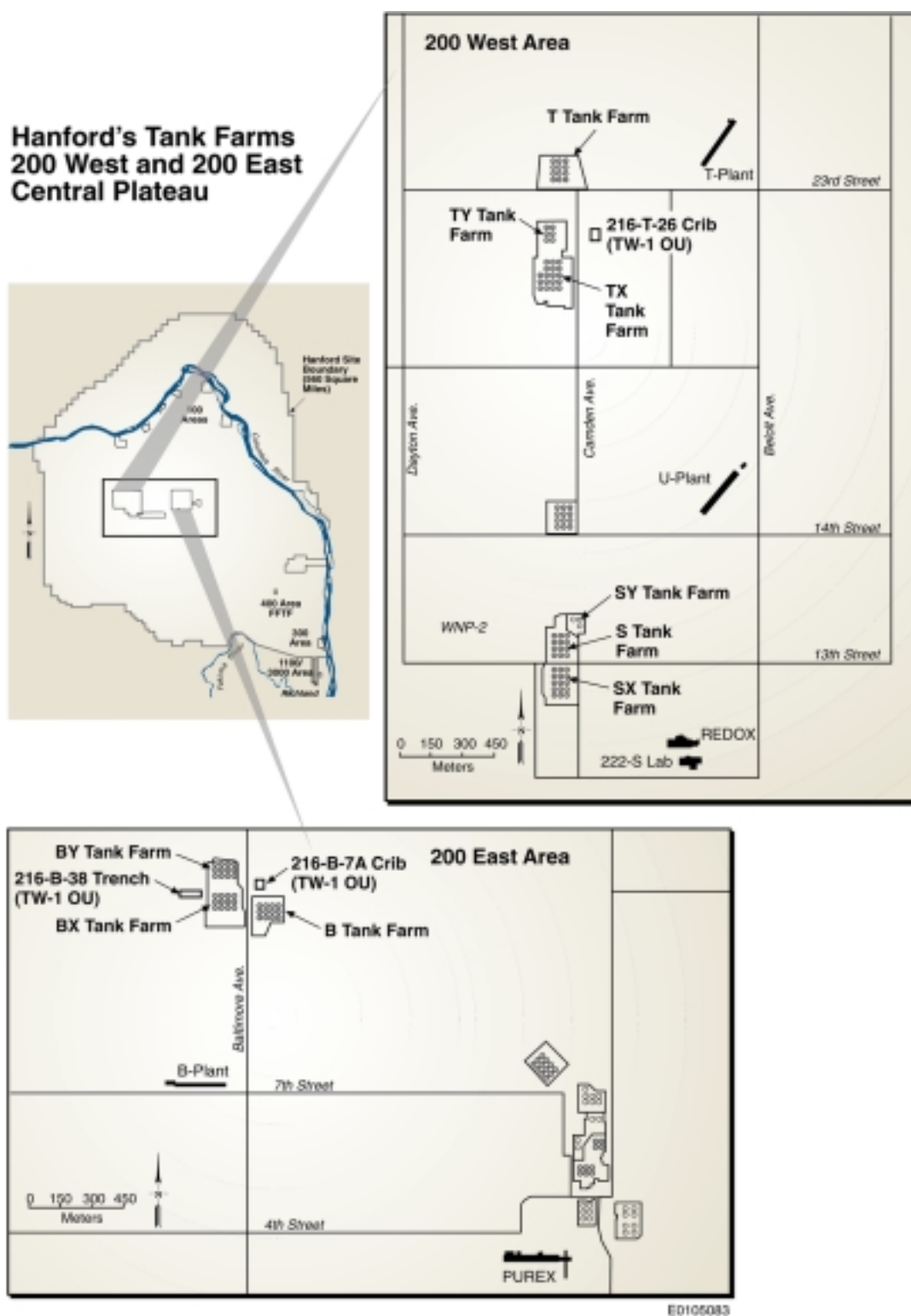
For the ISRM barrier, the remainder of the 28 injection wells and 4 monitoring wells planned for Phase 2 will be installed during the next period. When the chemical barrier is established at the new injection wells, the total barrier length across the chromium plume will nearly double (to 495 meters). For the pump-and-treat systems, a new well will be installed at each operation location in the 200 Area.

Barrier Study. During the next period, a single site will be selected as the new borrow site for the silty loam needed for constructing long-term barriers.

ILAW PA. Results from the air permeability measurements of glass, and the geologic, hydraulic, and geochemical analyses on borehole samples, will be reported during the next period.

* The schedule options study was described in the “Project Overview and Budget” section, page 23, of the GW/VZ November 2000 Semi-Annual Report to Congress.

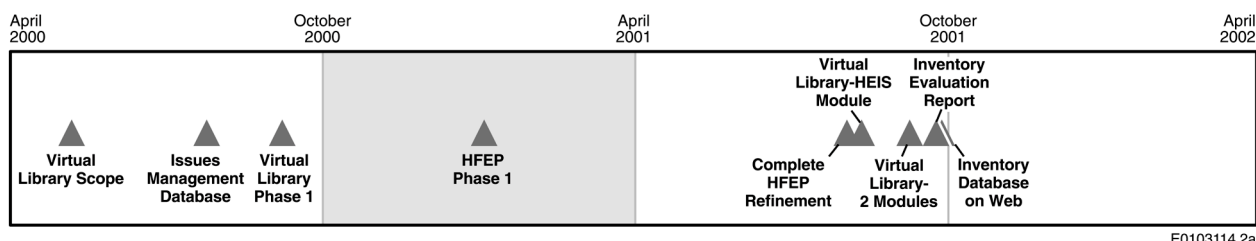
Section 4 – Integration Project Status Update



A Hanford Site Tank Farm Map, showing the B-BY-BX, S-SX, T-TX-TY tank farms.

Section 4 – Integration Project Status Update

INTEGRATION OF INFORMATION



E0103114.2a

The Integration of Information endeavor will help to ensure that the wealth of technical information and data about the Hanford Site is well integrated, effectively managed (to ensure its integrity, quality, and configuration control), and easily accessible for a wide range of potential uses. A major objective of this endeavor is to prepare datasets, interpret data, and describe the current best understanding (in the form of *conceptual models*) for the SAC.

TIMELINE AND KEY MILESTONES

Note: Items that appear in bold, below, are “keyed” to match milestones presented in the timeline (above) for this section.

The first phase of work on the Hanford Features, Events, and Processes (HFEP) database, which identifies factors to be considered in developing conceptual modeling, was completed in January 2001 (**HFEP Phase 1**). The Phase 2 development (described below) is scheduled for August 2001 (**Complete HFEP Refinement**).

A report on the inventory data assembled for use in the initial site-wide assessment with the SAC (Rev. 0) will be issued in September 2001 (**Inventory Evaluation Report**). The inventory data will also be made available on the Internet by the end of FY01 (**Inventory Database on Web**). Data from the Hanford Environmental Information System (HEIS) database will be available through the Virtual Library by August 2001 (**Virtual Library-HEIS Module**). Two additional modules—one for the inventory data used in the SAC initial assessment, the other on effluent volumes released to the soil at liquid discharge sites—are expected to be in the Virtual

Library by the end of FY01 (**Virtual Library-2 Modules**).

SIGNIFICANT EVENTS THIS PERIOD

HFEP Database. The HFEP database includes nearly 1,800 Features, Events, and Processes (FEP) gathered from geohydrologic studies at eight international sites (the international FEP set).^{*} Additional FEP that are important at the Hanford Site, but were not included in the international set, have been added to the HFEP database.

The Phase 2 development of the HFEP database will refine the initial set of FEP (eliminating those not relevant to the Hanford Site), in order to provide traceability to the original set of international FEP and correlation with the process relationship diagrams developed for the Hanford Site.

The second effort for Phase 2 focuses on resolving key issues in the state of knowledge needed to develop and implement conceptual models for site-wide assessments. Among the key issues being addressed are the inventory of nuclear materials at the Hanford Site, integrating the information on release models, providing a better basis for selecting the distribution coefficient (K_d) values used in vadose zone and groundwater models, and improving the technical basis for assessing human risks. The information derived

^{*} A report of a Nuclear Energy Agency working group on the development of a database of FEP is available in *Safety Assessment of Radioactive Waste Repositories, An International Database of Features, Events, and Processes*, Nuclear Energy Agency, December 1999.

Section 4 – Integration Project Status Update

from the solutions proposed to address these issues will be used to update the HFEP database.

Conceptual Models and Process Relationship Diagrams. Based on lessons learned from using FEP in assessments for the Yucca Mountain Project, the Integration Project has been developing a series of process relationship diagrams. These diagrams graphically represent how the environmental system works, and show the interrelationships between relevant factors represented in a conceptual model.

During this period, process relationship diagrams were used successfully to develop and document conceptual models at two operable units within the 200 West Area. The process relationship diagrams also facilitated discussion among principal scientists. These practical results show how such diagrams provide a consistent framework and methodology for developing conceptual models.

Virtual Library. Planning for the next stage of the Virtual Library was completed in January. This planning reflects the development process outlined in DOE Guide 200.1-1, *Software Engineering Methodology*. Three modules will be developed in FY01 for (1) distribution of HEIS data; (2) SAC Inventory data; and (3) data related to process effluents released to the soil at liquid discharge sites.

SIGNIFICANT EVENTS NEXT PERIOD

HFEP Database. As noted above, part of the Phase 2 effort will focus on organizing a refined set of Hanford FEP that are traceable to the international set of FEP and to factors specific to the Hanford Site. Completion of the HFEP refinement is currently planned for August 2001 (**Complete HFEP Refinement**).

The second major effort in Phase 2, which involves the interpretation and integration of isolated data and the resolution of high-priority issues for conceptual model development, will continue through the next period and into the first half of FY02. A report documenting the methods

used to develop the inventory baseline for the initial SAC (Rev. 0) assessment is planned for delivery by the end of September 2001 (**Inventory Evaluation Report**).

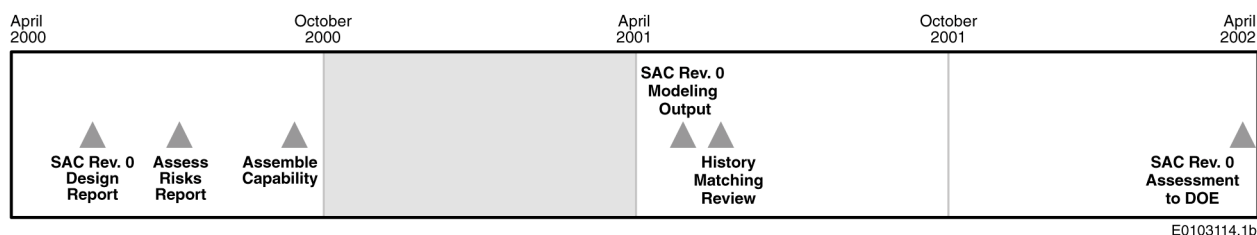
Conceptual Models and Process Relationship Diagrams. A technical paper is being prepared to document the approach and methodology for ensuring consistency and comprehensiveness in conceptual models, using the tools and experience gained through use of FEP, along with process relationship diagrams. Completion of the draft is planned for late September 2001.

Virtual Library. System-level requirements and designs for the HEIS module of the Virtual Library are to be completed in April 2001. The requirements for this module were developed from the prototype that was completed in September 2000. The detailed design will be completed by the end of May 2001. A period of programming, test, and installation will follow. The HEIS module is planned to be operational by the end of August 2001 (**Virtual Library-HEIS Module**).

Concurrent with HEIS module development, two additional modules will begin development in June. One of these modules will provide the inventory data used in the initial assessment that is run using the SAC (Rev. 0). The inventory data will also be made available on the Integration Project web site by September 2001 (**Inventory Database on Web**). The second module, called the Effluent Volume to Soils Disposal Sites module, will contain information on contaminants that are released to surface disposal sites. Both of these modules are planned to be operational by September 2001 (**Virtual Library-2 Modules**).

Section 4 – Integration Project Status Update

SYSTEM ASSESSMENT CAPABILITY



The SAC will assess future cumulative site-wide impacts resulting from the environmental release of contaminants during past Hanford Site operations, or from current waste storage locations. The SAC is also envisioned as a tool for assessing the merits of remediation, isolation, and containment alternatives for specific areas of the Hanford Site.

At the heart of the SAC is a set of models for simulating two sets, or layers, of *technical elements* (see the diagram below). There are five technical elements in the Environmental Layer of the SAC. First is the *inventory* of potential contaminants from past Hanford Site operations. Next is the *release* of contaminants to the environment through deliberate disposal actions or accidents (such as spills and leaks). The third element follows the transport and fate of contaminants as they move through the unsaturated strata of the *vadose zone*. When contaminants reach the *groundwater* (the fourth element) beneath the Hanford surface, they can

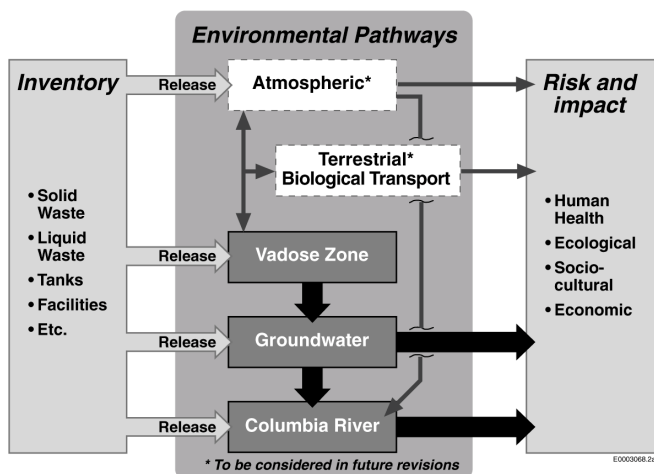
flow toward the groundwater-river interface. From there they enter the *Columbia River* ecosystem (the fifth element).

The Risk and Impact Layer of the SAC will include four technical elements to model *human risks, ecological risks, economic impacts, and socio-cultural impacts*.

TIMELINE AND KEY MILESTONES

Note: Items that appear in bold, below, are “keyed” to match milestones presented in the timeline (above) for this section.

The start of peer review on the history matching work for SAC (Rev. 0) has been moved from March to June 2001 (**History Matching Review**). Modeling runs for the SAC (Rev. 0) will begin in May (**SAC Rev. 0 Modeling Output**). The delivery date for the Rev. 0 summary assessment document has been tentatively rescheduled from September 2001 to March 2002 (**SAC Rev. 0 Assessment to DOE**), due to FY01 budget reductions.



SAC Technical Elements: Inventory, Environmental Pathways, and Risk and Impact.

SIGNIFICANT EVENTS THIS PERIOD

The Integration Project team has developed an inventory for 10 waste contaminants of concern. The inventory contains individual, location-by-location estimates of the amount of each constituent. The resulting inventory database provides a major source of data for the Inventory technical element of the SAC (Rev. 0). Modeling runs using the site-specific inventory database and other data sources began in March 2001.

Section 4 – Integration Project Status Update

All of the required conceptual models and their software implementations for the SAC (Rev. 0) have been completed and assembled, ranging from the Inventory technical element through the Risk and Impact technical elements. History matching runs to test the models and software implementations in the SAC (Rev. 0) began in March. During history matching, the SAC models for a technical element are tested by running them for a period in the past and comparing the results with available field measurements.

At the time of this report, the history matching runs for each technical element had been completed. In addition, the entire capability has been tested by conducting an initial run of the system. Even at this early stage, some valuable insights into improving and refining the SAC technical elements have emerged. In the Vadose Zone technical element, for example, the history matching work has highlighted model parameters that need to be more closely matched (using conditional selection criteria) when values are randomly chosen for individual runs, or **realizations**. Selecting different values for an input parameter within a defined range for successive realizations is essential for estimating the uncertainty in modeling results. Refining the models to include conditional selection criteria for the input values to a realization will make future SAC assessments more realistic and accurate.

Another valuable insight from history matching efforts will shorten the time required to perform the multiple realizations needed to produce uncertainty measures that can be carried through the technical elements. The computational architecture for the SAC (Rev. 0) uses the same processor to perform all the realizations for a given contaminant. The Integration Project team has found that the total run time can be reduced by allocating realizations for one contaminant to multiple processors. Experience with using all the “computer cycles” available to the SAC will lead to more efficient scheduling of computing resources, thereby allowing more realizations to be completed in less time.

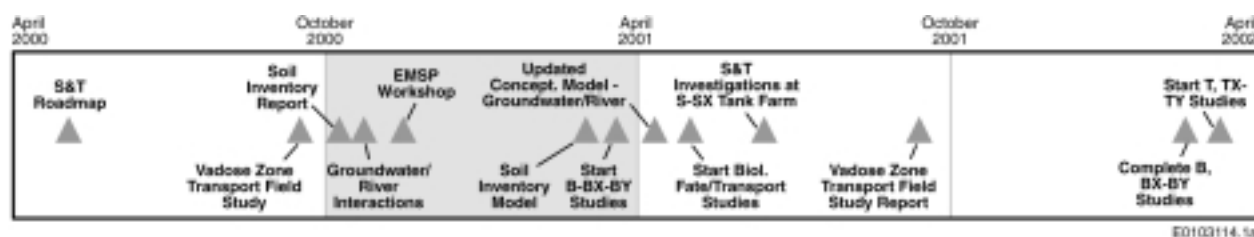
SIGNIFICANT EVENTS IN THE NEXT PERIOD

A panel of independent outside experts will perform a technical review of the procedures and results of the history matching effort (**History Matching Review**). The review is now scheduled to begin in June 2001, with the review panel’s report expected a month later. The SAC team anticipates that this review will add to the lessons being learned from the SAC (Rev. 0), which will guide the next round of improvements that are incorporated in the SAC (Rev. 1).

The SAC team expects to present the initial site-wide assessment results from the SAC (Rev. 0) to regulators at a meeting in August 2001.

Section 4 – Integration Project Status Update

SCIENCE AND TECHNOLOGY



The S&T endeavor will provide new knowledge, data, and tools for the cleanup and stewardship mission at the Hanford Site. In addition to promoting new technologies and methods to solve Hanford's problems, this endeavor seeks to improve the scientific basis for decisions on protecting the Columbia River and its ecological systems, while preparing the Hanford Site for the future. S&T activities are funded by the Integration Project, by the DOE EMSP, and by the Subsurface Contaminants Focus Area of the DOE Office of Science and Technology.

TIMELINE AND KEY MILESTONES

Note: Items that appear in bold, below, are "keyed" to match milestones presented in the timeline (above) for this section.

The **Soil Inventory Report**, containing data for use in the SAC (Rev. 0), was delivered in October 2000. A report documenting the model that was used to generate the data and the work to date was published in March (**Soil Inventory Model**). The second **EMSP Workshop** was held in November.

Preparations continued through March for laboratory studies on biological fate and transport issues relevant to Hanford Site contaminant transport pathways. These studies are now scheduled to begin in May (**Start Biol. Fate/Transport Studies**). Experimental and modeling studies for **S&T Investigations at S-SX Tank Farm** were completed during this period (ahead of schedule), and data from the studies were prepared for the draft S-SX Tank Farm Field Investigation Report. Experimental studies for the B-BX-BY Tank Farm complex started in March (**Start B-BX-BY Studies**).

SIGNIFICANT EVENTS THIS PERIOD

EMSP Workshop. The second workshop for investigators in the EMSP research program was held in November 2000. In addition to the 41 EMSP investigators who attended, there were participants from RL, the DOE ORP, the Integration Project, and the core projects.

Soil Inventory Model Report. The Soil Inventory team delivered estimates of soil contaminants at individual waste disposal locations to the SAC team in October 2000. The task managers decided that a narrative report on progress to date would also be useful. The team therefore published a document describing the SIM and its application to soil waste sites on the Central Plateau. For the SAC (Rev. 0), the model was applied to generate inventory estimates for 46 radionuclides and 27 chemicals at 88 liquid-waste disposal sites. These inventory estimates included measures of the uncertainties in the results, based on the uncertainties in the input data.

During this reporting period, the tasks for **Field Investigations at Representative Sites** and **Transport Modeling Study** completed laboratory and modeling studies of the S-SX Tank Farm and provided input to the draft S-SX Field Investigation Report that is being prepared by the RPP. The S&T evaluations, which will be summarized in an appendix to the field investigation report, complete several specific milestones in the S&T Roadmap. The research has addressed a number of key scientific issues associated with composition of tank wastes that leaked to the vadose zone, the chemical species present in tank wastes from the reduction-oxidation (REDOX) process, movement of water and contaminants through the vadose zone in and

Section 4 – Integration Project Status Update

near the S-SX Tank Farm, and the geochemical behavior of cesium-137, chromium, and technetium-99. These issues were studied through experiments with uncontaminated and contaminated subsurface sediments, and through modeling studies of heat, water, and contaminant flows through the vadose zone. Key results of this research, which will be summarized in the appendix to the field investigation report, include (1) conceptual models of water and waste migration in the vadose zone; and (2) future migration and in-ground chemical behavior of waste components, as they may influence future discharges to groundwater, the need for corrective actions, and leak-loss limits for tank waste sluicing.

The **Vadose Zone Transport Field Study** evaluated results from the field experiment last summer, in which water and dilute tracers were injected to the vadose zone, and began preparations for injection of a high-salt tracer later this year. Preparations for the upcoming field test included updating the test plan (the plan is available at <http://www.bhi-erc.com/projects/vadose/sandt/stdocs.htm>), obtaining permits for field activities and injection of a high-salt tracer (sodium thiosulfate), and conducting pre-activity field inspections and safety briefings. The 2001 field experiment will be conducted this spring. A document describing the fieldwork in both years will be published at the end of September 2001 (**Vadose Zone Transport Field Study II**).

The **Field Investigations at Representative Sites** task has received samples from the borehole drilled near the BX-102 tank for the Tank Farm Soil Characterization Project. Scientific studies on these sample materials have been initiated.

Laboratory preparations continued for the **Biological Fate and Transport Study**. This task will investigate the biological uptake of contaminants through controlled laboratory experiments. Through interactions with a science-user coordination team, the task has selected technetium-99 uptake by rainbow trout and a common aquatic insect for study.

SIGNIFICANT EVENTS IN THE NEXT PERIOD

The **Soil Inventory** task will complete an evaluation of additional waste streams and waste sites using the SIM. A significant difference in this round of estimates will be that waste volumes and inventories will be reported by the month of their disposition to a waste location, rather than by the (average) annual values that have been previously reported. These refined estimates will provide more precise input to the next version of the SAC.

Wrap-Around Science. The Field Investigations at Representative Sites and Transport Modeling tasks will report on results of the S-SX investigation, and begin studying samples from the BX-102 borehole, along with other samples that will be collected in the BX Tank Farm by the RPP.

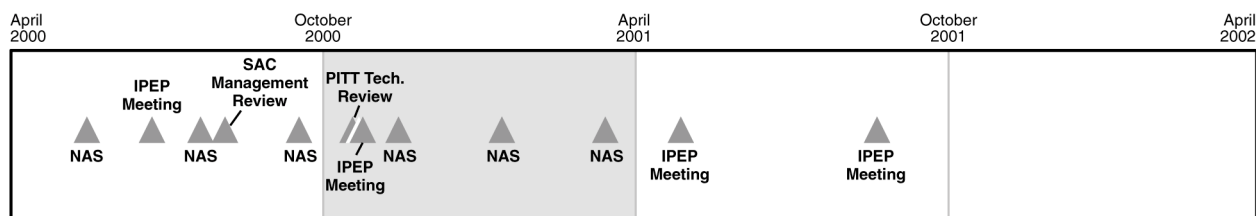
The **Vadose Zone Transport Field Study** will conduct field experiments with injection of a high-salt tracer. The test will be conducted at the same facility used for last year's experiment.

The **Groundwater/River Interface** Task will complete the extension of conceptual and numerical models to additional key areas along the Columbia River, beyond the 100 H Area (which was completed last year).

The **Biological Fate and Transport Study** task will complete the initial laboratory studies of technetium-99 uptake by aquatic species.

Section 4 – Integration Project Status Update

TECHNICAL REVIEW



E0103114.2b

The Technical Review Endeavor ensures that outside, independent reviews are conducted for the scientific merit, technical content, and managerial leadership of Integration Project activities. Technical review activities in support of the Integration Project include the IPEP, study committees of the NAS/National Research Council, reviews of the Hanford consolidated groundwater model, and other project-specific reviews.

The IPEP, which has eight members from diverse disciplines, provides broad and independent oversight for all Integration Project activities. Panel members review and comment on key programmatic, managerial, technical, and stakeholder issues. The IPEP operates primarily as a merit review panel, but periodically conducts technical reviews.

TIMELINE AND KEY MILESTONES

Note: Items that appear in bold, below, are “keyed” to match milestones presented in the timeline (above) for this section.

The **IPEP** met in October 2000 and in April 2001. Another meeting is scheduled for September 2001.

The NAS Committee on Environmental Remediation Science and Technology at the Hanford Site (**NAS**) met in November 2000, January 2001, and March 2001.

The Partitioning Interwell Tracer Test (PITT) Technical Review was delivered in October 2000 (**PITT Tech. Review**).

SIGNIFICANT EVENTS THIS PERIOD

IPEP. The IPEP concluded its October meeting with a report that contained 14 recommendations. Most of these pertained to presentations made by Integration Project staff on Columbia River environmental monitoring, ecological risk, and groundwater remediation. Several areas in which the IPEP recommended additional work have been presented in detailed work plans proposed to the DOE by the Integration Project. However, these projects have fallen below the funding line in the RL Integrated Priority List for Hanford Site projects.

At the October meeting, the IPEP decided to conduct its work as a full panel, without breaking into subpanels for special topics. Members are free to serve individually on other technical or management review panels established by the Integration Project or by RL, but these panels will not be managed by the IPEP.

NAS Committee on Environmental Remediation Science and Technology at the Hanford Site. Three meetings of the NAS committee were conducted, and the committee is formulating its findings and preparing a final report. Integration Project team members met with the committee at its November meeting in Irvine, California. The discussion focused on the S&T Roadmap and plans for the risk assessment technical area. During a January teleconference session, the committee requested that the Integration Project staff report on the S&T contributions to S-SX Tank Farm soil characterization. This was the focus of presentations to the committee at its March meeting in Washington, D.C. Further information on the NAS committee can be accessed through a

Section 4 – Integration Project Status Update

link from the Integration Project's web site, at
<[http://www.bhi-erc.com/
projects/vadose/peer/nas.htm](http://www.bhi-erc.com/projects/vadose/peer/nas.htm)>

PITT Technical Review. A technical review panel assessed the proposal for a PITT in those areas where carbon tetrachloride (or other dense non-aqueous phase liquids) may be present in the vadose zone. The panel's report, which was delivered in October 2000, recommended that a decision on the PITT be deferred until additional characterization data are available.

SIGNIFICANT EVENTS IN THE NEXT PERIOD

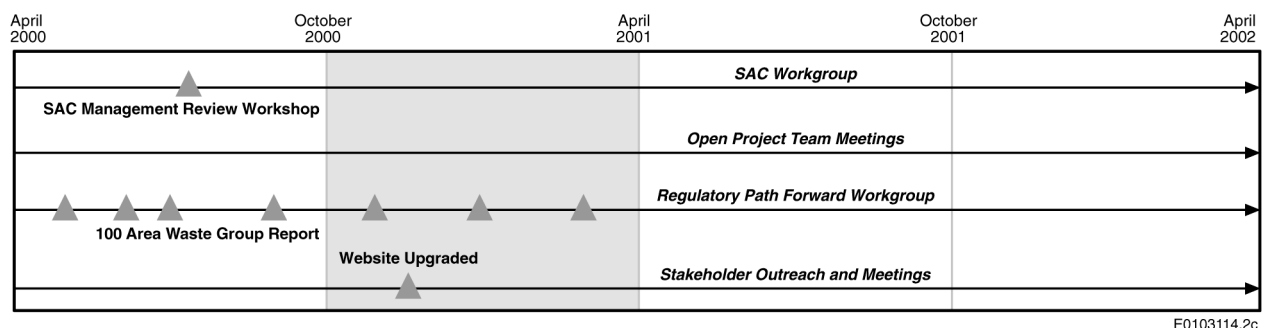
IPEP. The most recent IPEP meeting was conducted on April 25-27, 2001. Technical topics included the SAC history matching exercise and the soil characterization work at the S-SX Tank Farm, including the S&T component of the work. Another topic was the IPEP's role in the transition of the Integration Project, which is planned for June 2002. The next IPEP meeting is planned for September 2001.

NAS Committee. The final report from the committee is scheduled for release and publication during the summer of 2001.

SAC History Matching Review. A technical review of the SAC history matching exercise is currently scheduled for June 2001. This review activity is described in the status update section for the SAC.

Section 4 – Integration Project Status Update

PUBLIC INVOLVEMENT



E0103114.2c

The Public Involvement Endeavor provides opportunities for Hanford's community of affected people to (1) share information and views; (2) consult with DOE and Integration Project staff; and (3) collaborate on Integration Project activities. Maintaining mutual trust and support to move ahead on difficult issues requires a fully open, accessible, and inclusive program for involving all those interested in Hanford's cleanup, as well as protection of the Columbia River.

TIMELINE AND KEY MILESTONES

Nine open project team meetings were held during this reporting period. These meetings will continue throughout the remainder of FY01 and into FY02. The meeting frequency will change from semi-monthly to monthly, effective June 4, 2001. Additional public involvement activities, which occur as part of the other Integration Project endeavors, are shown on the timelines for those endeavors.

SIGNIFICANT EVENTS THIS PERIOD

Integration Project Information on the Internet. The web site upgrade for the Integration Project was released in March 2001, as part of the overall Internet web site upgrade for the Environmental Restoration Contractor (ERC). The new uniform resource locator (URL) for the Integration Project home page is <http://www.bhi-erc.com/projects/vadose/>.

Outreach. Integration Project staff members continually meet with interested groups and organizations to discuss the ongoing work of the Integration Project, and to receive comments and suggestions. During this period, project staff met with the following organizations and Tribal Nations:

- The Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology)
- The Oregon Office of Energy and the Oregon Hanford Waste Board
- Technical representatives of the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, and the Yakama Nation.

Open Project Team Meetings. The principal topics discussed at the nine open project team meetings are listed below. Detailed minutes of each meeting, which are distributed to over 200 individuals and organizations, are also available on the Integration Project web site at <http://www.bhi-erc.com/projects/vadose/public/minutes.htm>.

- **October 2, 2000.** Review team, budget, and planning for the PITT. Status of ISRM well emplacement. Decommissioning of unnecessary old RCRA wells. Drilling program for new RCRA wells. Status of Tank Farm Vadose Zone Characterization at B-BX and S-SX Tank Farms. Update on tritium investigation at the 618-11 Burial Ground. Visit of the NAS study committee to the Hanford Site.

Section 4 – Integration Project Status Update

- **October 16, 2000.** Agendas for November meetings of the IPEP and NAS study committee. SAC history matching. S&T scheduled support for SAC and tank farms characterization. Barrier study. Update on tritium at 618-11 Burial Ground. RCRA well drilling. Status of work on S-SX Tank Farm soil characterization.
- **November 6, 2000.** Results from the IPEP meeting in October. S&T workshop for EMSP principal investigators. SAC schedule.
- **December 4, 2000.** Status of groundwater pump-and-treat operations. EMSP workshop. SAC model for the Release technical element. Review of groundwater monitoring by Ecology. Update on tritium investigation at the 618-11 Burial Ground.
- **December 18, 2000.** IPEP. RCRA well drilling status. Status of ISRM well emplacement. Borehole drilling for the B Tank Farm soil characterization.
- **January 8, 2001.** Closeout report from the October IPEP meeting. Status of work on the 200 Area Waste Assessment Project, and a presentation to the Hanford Advisory Board (HAB) Environmental Restoration Committee. Borehole drilling for the B-BX Tank Farms soil characterization. Schedule for T-TX Tank Farm characterization. National Vadose Zone S&T Roadmap.
- **February 5, 2001.** IPEP future meetings and major topics. Early results from borehole samples in the B-BX Tank Farms soil characterization. National Vadose Zone S&T Roadmap. SAC history matching efforts for inventory constituents.
- **March 5, 2001.** Presentations planned for the last meeting of NAS study committee. Status of B-BX Tank Farms soil characterization. Budget workshops for core projects and the Integration Project.

- **March 19, 2001.** Next set of ISRM injection wells started. Borehole started for ILAW field study. Integration Project management meetings with Ecology and the Oregon Office of Energy. Questions about inventory estimate for technetium-99. No observed damage at the Hanford Site from the February 28 earthquake near Olympia.

SIGNIFICANT EVENTS IN THE NEXT PERIOD

Open Project Meetings. The Integration Project staff will continue to hold open project team meetings on a monthly basis. Minutes of the meetings will be posted on the Integration Project web site.

Outreach. The Integration Project will continue its interaction with the HAB and its committees. The HAB will conduct three board meetings during the upcoming reporting period, as well as several committee meetings.

The Integration Project will also be seeking opportunities to provide updates to and receive comments from local, regional, and national groups. This effort will provide stakeholders, regulators, Tribal Nations, and technical groups with a broad understanding of the elements and issues associated with the Integration Project.

Section 5

FOR MORE INFORMATION

GENERAL INFORMATION ABOUT THE GROUNDWATER/VADOSE ZONE INTEGRATION PROJECT

Published reports and documents, along with many other sources of background information on the Integration Project, are available at the following Internet locations:

Integration Project home page:
<http://www.bhi-erc.com/projects/vadose/>

Hanford Site home page:
<http://www.hanford.gov/>

Office of River Protection home page:
<http://www.hanford.gov/orp/index.html>

Hanford stakeholders:
http://www.hanford.gov/misc_info/stakehld.htm

The Integration Project home page has links to other DOE, national laboratory, and community or stakeholder sites that have information related to the Hanford Site and environmental remediation work.

FURTHER INFORMATION ON SIGNIFICANT EVENTS AND FEATURES IN THIS REPORT

Further information on the workshops for investigators in the EMSP is available on the Internet at <http://www.pnl.gov/emsp/>. Information about the EMSP (in general) can be found on the Internet at <http://emsp.em.doe.gov>.

The 200 Area Implementation Plan (200 Areas Remedial Investigation/Feasibility Study Implementation Plan - Environmental Restoration Program, DOE/RL-98-28, Rev. 0, April 1999) is available through the ER Project Internet Library, at <http://www.bhi-erc.com/library/doerl/rl98-28.pdf>.

Information on the Science and Technology Endeavor is available on the Internet at <http://www.bhi-erc.com/projects/vadose/s&t.htm>.

Documents and reports by the System Assessment Capability Endeavor are available on the Internet at <http://www.bhi-erc.com/projects/vadose/sac/sacdocs.htm>.

Peer review and technical review activities are described on the Internet at <http://www.bhi-erc.com/projects/vadose/peer.htm>. The agenda, close-out comments, and meeting reports for the IPEP are available on the Internet at <http://www.bhi-erc.com/projects/vadose/peer/ipep.htm>.

For more information, or to become involved with the Integration Project, please contact Karen Strickland at (509) 372-9236.

Appendix A

TACTICAL PROJECT LINKAGES

Project	Requirement	Integration Linkages
Tank Farm Vadose Zone Project (ORP)	<i>Tri-Party Agreement</i> Milestone: (M-45) (01/2002) S-SX Characterization	S&T/EMSP (April 2001) Geochemistry/reactive transport of Cs-137 Cr retardation mechanism Heat effects on moisture distribution and contaminant flux VZ transport field experiment EM-50 Project Hanford Vadose Zone Characterization
Tank Farm Vadose Zone Project (ORP)	<i>Tri-Party Agreement</i> Milestone: (M-45) (10/2002) B-BX-BY Characterization	S&T Laboratory and field studies (May 2002) Modeling studies (May 2002) EMSP Projects (May 2002) EM-50 Projects Hanford Vadose Zone Characterization
Groundwater Monitoring Program	<i>Tri-Party Agreement</i> Milestone: (M-24) Annual Groundwater Monitoring Network Wells	Site-Wide Support Integrated Sampling and Analysis Plan Integrate RCRA drilling characterization needs ILAW PA Groundwater Modeling (Jan 2001)
Immobilized Low Activity Waste (ORP)	DOE Order: (435.1) Performance Evaluation	Multi-Use Drilling (March 2001) 200 Area Remedial Action for 200-TW-1 Groundwater Monitoring Program Groundwater Monitoring Program Groundwater Monitoring (Jan 2001)
200 Area Environmental Restoration Remedial Action Project	<i>Tri-Party Agreement</i> Milestone: (M-15) (2005) 200-PW-1 Characterization Feasibility Study	COS Process Relationship Diagram S&T Laboratory and modeling studies (Pu and CCl ₄ Mobility) (Oct 2002) EMSP Projects (Pu Mobility) (Oct 2002)
200 Area Environmental Restoration Remedial Action Project	<i>Tri-Party Agreement</i> Milestone: (M-15) (2004) 200-PW-2 Characterization Feasibility Study	S&T Laboratory and modeling studies (U Mobility) (2002) EMSP Projects U Mobility (Oct 2002) EM-50 Projects MSE Study Refine conceptual model for U Distribution

Appendix A – Tactical Project Linkages

Project	Requirement	Integration Linkages
200 Area Environmental Restoration Remedial Action Project	<i>Tri-Party Agreement</i> Milestone: (M-15) (2004) 200-TW-1 Characterization Feasibility Study	S&T/EMSP Pu Mobility (2002) ILAW PA Well characterization (March 2001)
200 Area Environmental Restoration Remedial Action Project	<i>Tri-Party Agreement</i> Milestone: (M-15) (2004) 200-CW-5 Characterization Feasibility Study	S&T Laboratory and modeling studies (2003) EMSP Projects Transuranic Waste mobility and modeling studies (2003)
200 Area Environmental Restoration Remedial Action Project	<i>Tri-Party Agreement</i> Milestone: (M-15) (2003) 200-CW-1, CS-1 Characterization Feasibility Study	GW Monitoring (Aug 2000) VZ Characterization dual use well drilling
Groundwater Management	<i>Tri-Party Agreement</i> Milestone: 5 year review 200-ZP-1 and Groundwater Remediation	EMSP Projects CCl ₄ projects (May 2002) 200 Area RA Soil Vapor Extraction Remediation of CCl ₄ Groundwater CCl ₄ remediation CCl ₄ Innovative Treatment and Remediation Demonstration (ITRD) project National Energy Technology Laboratory (NETL) access to deep CCl ₄ contamination project EM-50 Projects Barrier performance monitoring



www.bhi-erc.com/projects/vadose